Characteristics of Nonsmoking Women Exposed to Spouses Who Smoke: Epidemiologic Study on Environment and Health in Women from Four Italian Areas

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The aim of this study was to evaluate whether risk factors associated with cardiovascular or respiratory diseases and lung cancer occur differently among nonsmoking women in Italy with and without exposure to environmental tobacco smoke (ETS) from husbands that smoke. We performed a cross-sectional study of 1,938 nonsmoking women in four areas of Italy. Data on respiratory and cardiovascular risk factors and on diet were collected using self-administered questionnaires. Medical examinations and blood tests were administered; urine cotinine levels were measured. Nonsmoking women ever exposed to husbands' smoking were compared with unexposed women for several factors: education, husband's education, household crowding, number of children, current or past occupation, exposure to toxic substances at work, parental diseases, self-perceived health status, physician-diagnosed hypertension, hypercholesterol, diabetes, osteoporosis, chronic respiratory diseases, blood pressure medications, lifestyle and preventive behaviors, dietary variables, systolic and diastolic blood pressure, body mass index, waist–hip ratio, triceps skin folds, plasma antioxidant (pro-) vitamins (α- and β-carotene, retinol, L-ascorbic acid, α-tocopherol, lycopene), serum total and HDL cholesterol, and triglycerides. Women married to smokers were more likely to be less educated, to be married to a less educated husband, and to live in more crowded dwellings than women married to nonsmokers. Women married to smokers were significantly less likely to eat cooked [odds ratio (OR) = 0.72; 95% confidence interval (CI), 0.55–0.93] or fresh vegetables (OR = 0.63; CI, 0.49–0.82) more than once a day than women not exposed to ETS. Exposed women had significantly higher urinary cotinine than unexposed subjects (difference: 2.94 ng/mg creatinine). All the other variables were not more prevalent among exposed compared to unexposed subjects. The results regarding demographic factors are easily explained by the social class distribution of smoking in Italy. A lower intake of vegetables among exposed women in our study is consistent with the available literature. Overall, our results do not support previous claims of more frequent risk factors for cardiovascular and pulmonary diseases among ETS-exposed subjects. In Italy, as elsewhere in Europe and North America, women who have never smoked but are married to smokers are likely to be of lower social class than those married to never-smokers. However, once socioeconomic differences are considered, the possibility of confounding in studies on the health effects of ETS is minimal. *Key words*: confounding, environmental tobacco smoke, epidemiology, ischemic heart diseases, lung cancer, passive smoking, respiratory diseases. *Environ Health Perspect* 108:1171–1177 (2000). [Online 13 November 2000]
http://ehpnet1.niehs.nih.gov/docs/2000/108p1171-1177forastiere/abstract.html

Several studies have indicated that exposure to environmental tobacco smoke (ETS) from spouses who smoke is associated with an increased risk of lung cancer (*1–3*) and ischemic heart disease (*4,5*) among nonsmoking women. In addition, living with a smoker is linked with respiratory symptoms and lung function decrements, although there are several uncertainties that make a judgment about causality difficult (*6*). The excess risks associated with ETS exposure are usually small (20–50% increase), and confounding from other known risk factors (including diet and exposure to occupational carcinogens) has been a reason for scientific (*7*) and public concerns.

The extent of confounding depends on the strength of the relationship between the confounder and the outcome under study, as well as on the asymmetry of the distribution of the confounder in the unexposed and exposed populations. The latter aspect is obviously population specific. It is not surprising that the studies comparing the characteristics of nonsmoking women exposed and unexposed to smoking by their spouses have yielded controversial results. Some investigators have found differences in sociodemographic and dietary characteristics; women married to a smoker were more frequently of lower socioeconomic status, more likely to be employed in manual occupations, and less prone to eat fruits and vegetables, especially those containing β-carotene (*8,9*). Kawachi and Colditz (*7*) detected a more hazardous pattern of risk factors for cardiovascular diseases (hypertension, diabetes, hypercholesterolemia, higher body mass index, saturated fat intake) among nonsmoking nurses enrolled in the Nurses Health Study and exposed to ETS at home. In contrast, a close examination of 13 risk factors for heart disease among nonsmoking adults from the Third National Heath and Nutrition Examination Survey (NHANES III) in the United States did not reveal significant differences between exposed and unexposed women (after controlling for educational status) apart from dietary carotene intake, which was lower among exposed subjects (*10*). In a recent report from Switzerland, no differences between women exposed and unexposed at home were found regarding sociodemographic characteristics, daily energy sources, food, and nutrients intake (*11*).

We conducted a study on the characteristics of nonsmoking women living in four areas of Italy to evaluate whether certain risk factors (sociodemographic factors, medical conditions, preventive behaviors, and dietary habits) potentially associated with cardiovascular or respiratory diseases and lung cancer are found differentially among women with

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We thank T. Sapigni (University of Ferrara), C.A. Perucci (Agenzia Sanità Pubblica, Lazio, Rome), and R. Saracci (CNR Institute of Clinical Physiology, Pisa) for their scientific and technical suggestions; and D. Kriebel for his comments to an earlier draft of the paper. We also thank the women who participated in the study. For their collaboration in data collection, we thank R. Puntoni (Pisa), A. Bigazzi (Pisa), T. Sampietro (Pisa), R. Licitra (Pisa), F. Bigazzi (Pisa), A. Patricelli (Pisa), A. Rosellini (Pisa), A. Angino (Pisa), B. Attisani (Pisa), F. Martini (Pisa), B. Piegaia (Pisa), G. Lazzeri (Pisa), P. Silvi (Pisa), L. Zen (Ferrara), E. Baraldi (Ferrara), M.T. Prosdocimi (Ferrara), and A. Quercia (Viterbo).

This work was funded in part by the Center for Indoor Air Research, Linthicum, MD, USA (contracts 96-18 and 96-18A).

Received 9 June 2000; accepted 29 August 2000.

and without exposure to ETS from their husbands. Laboratory data on urinary cotinine concentrations were used to validate the nonsmoking status of the women, and blood samples were taken to compare plasma levels of (pro-) vitamins and lipids among exposed and unexposed subjects.

Methods

Subjects. The study was conducted in four areas characterized by different economic backgrounds and urbanization levels: the Po River Delta (a rural area in North Italy), Pisa (a historic, middle-sized town in Tuscany, Central Italy), Viterbo (a small town including the nearby rural area in Lazio, Central Italy), and the metropolitan area of Rome (Central Italy). These areas were chosen because they had been examined in previous population studies which had already ascertained the smoking status of women. This made the selection of never-smoking women for the present study more efficient. A cross-sectional study through an interviewer-administered, standardized questionnaire was conducted in the Po River Delta and in Pisa from 1988 to 1993 (*12,13*) to evaluate the role of air pollution on respiratory conditions in the general population (8–97 years; response rates: 67% and 69%, respectively). Among the women participating in these studies (1,499 in the Po River Delta and 1,553 in Pisa), there were 1,811 women that had reported never being smokers at the time of initial interview (805 in Po River Delta and 1,006 in Pisa). A nationwide study on asthma prevalence among 6–7- and 13–14-year-old children, from randomly chosen primary and middle schools within defined geographical areas, was conducted in Italy in 1994–1995 (*14–17*) within the International Study of Asthma and Allergies in Childhood initiative (*18*). The areas of Viterbo and Rome were included in this study. Self-administered questionnaires were filled out by the parents of the child, and they included information on the lifetime smoking habits of the mother. A high response rate was obtained (94.1% in Viterbo and 91.7% in Rome). From the list of natural mothers whose smoking habits were known, a total of 4,880 women who had never smoked were identified. The present study was restricted to women residents in two subareas of the Viterbo province (586 subjects) and in the western part of Rome (1,261 subjects). This restriction of the areas was done to facilitate women's access to the medical centers. The total number of women selected in the four areas was 3,658. During 1997, the vital status and permanent address of those women were ascertained at the local municipal registers, and due to moving or death, 3,330 women remained eligible for the study.

Questionnaires. The data collection was performed from September 1997 through the end of 1998. The study was approved by the Ethical Committee of the Catholic University in Rome. Eligible subjects were invited by mail, subsequent phone calls (mainly in Rome), and home visits by trained personnel to fill out two self-administered questionnaires (a core questionnaire and a food-frequency questionnaire). The study was presented as a survey on health status, environmental factors, and dietary habits, with no mention of the specific aims regarding ETS exposure. The questionnaires were sent by mail (Viterbo and Rome) or were hand delivered at home (Po River Delta and Pisa). The core questionnaire contained information on demographics, passive smoking exposure, exposure to toxic substances at work, familial medical history, personal medical history, physical exercise, and other preventive behaviors. We used the Italian version of the EPIC food-frequency questionnaire [a self-administered questionnaire designed and used in the ongoing European Prospective Investigation into Cancer of Diet and Nutrition (*19*)] to assess dietary habits. During the phone conversation or personal contact at home, the women were invited to participate in the medical examination and blood testing. The questionnaires had to be returned (and checked for completeness by trained personnel) the day of the medical examination. In cases when the medical examination was refused, the completed questionnaires were returned to the study center by mail. The women were motivated to participate by free medical and laboratory tests; all participants in Rome and in Viterbo received a grocery coupon (equivalent to $10 U.S.).

Medical examinations and biological samples. Informed consent was obtained, and the medical examinations were performed by a physician at the hospital site

Table 1. Odds ratios for demographic characteristics of women unexposed and exposed to husbands' smoking, 1997–1998.

Variable	Husbands' smoking: Unexposed *n*	Husbands' smoking: Exposed *n*	OR[a]	OR[b]	95% CI
Center					
Po Delta	184	220	1.00	1.00	—
Pisa	121	290	1.83	1.86	(1.36–2.49)
Roma	290	467	1.72	1.91	(1.42–2.57)
Viterbo	131	235	1.95	2.04	(1.47–2.82)
Age (years)					
25–34	113	117	1.00	1.00	—
35–44	313	474	1.37	1.40	(1.03–1.90)
45–54	161	308	1.82	1.83	(1.30–2.58)
55–64	89	172	2.13	1.95	(1.26–3.00)
65–74	50	141	3.03	2.77	(1.70–4.51)
Womens' education (years)					
> 13	92	120	1.00	1.00	—
9–13	252	362	1.24	1.24	(0.89–1.71)
6–8	187	314	1.44	1.44	(1.02–2.04)
< 6	193	413	1.54	1.54	(1.04–2.28)
Husbands' education (years)					
> 13	109	132	1.00	1.00	—
9–13	233	339	1.49	1.24	(0.88–1.76)
6–8	180	332	1.65	1.50	(1.01–2.22)
< 6	143	273	1.31	1.33	(0.86–2.06)
Household crowding (persons/room)					
Low (< 0.8)	287	434	1.00	1.00	—
Medium (0.8–1)	205	351	1.28	1.25	(0.97–2.36)
High (>1)	228	420	1.54	1.45	(1.11–1.89)
Number of children					
None	37	32	1.00	1.00	—
≤ 2	557	951	1.38	1.34	(0.75–2.38)
≥ 3	127	226	1.44	1.37	(0.74–2.54)
Women's current or past occupation					
Nonmanual	349	569	1.00	1.00	—
Manual	90	167	1.08	0.92	(0.66–1.30)
Self-employed, farmers, other occupation	152	281	1.02	0.91	(0.69–1.19)
Never employed, homemakers	115	172	0.82	0.72	(0.53–0.99)
Exposure to toxic substances at work (only among employed)					
No	466	810	1.00	1.00	—
Yes	125	207	0.92	0.89	(0.68–1.15)

Totals may vary because of missing values.
[a]Odds ratios adjusted for center, age, and center × age. [b]Odds ratios adjusted for center, age, center × age, and woman's education.

most convenient for each woman. Each subject undergoing physical examination was interviewed by the physician and had measurements taken of standing height, weight, circumferences of arm, waist, hips, and wrist and subscapular and triceps skin folds according to standardized procedures (*20*). Two measures of systolic and diastolic pressure, at an interval of 30 min, were performed using a mercury sphygmomanometer, and the mean of the two measurements was used. The subjects were asked to collect a sample of the first urine they passed on the day of the clinical examination. A blood sample of 30 cc was drawn in fasting conditions. Thirty minutes after being drawn, the blood sample was prepared for subsequent (semimonthly) delivery to a centralized laboratory for each determination.

Laboratory measurements. We used the blood sample to determine α- and β-carotene, retinol, L-ascorbic acid, α-tocopherol, lycopene, and lipidic pattern. A simultaneous measurement of fat-soluble compounds in serum was carried out using HPLC (*21*). The assay for determining L-ascorbic acid in serum was performed according to the NHANES III laboratory protocol (*22*). Total cholesterol, HDL cholesterol, and triglycerides were measured using standard enzymatic procedures performed by spectrophotometer on serum stored at 4°C. Urine cotinine levels were measured in duplicate with the radioimmunoassay (RIA) described by Van Vunakis et al. (*23*). We expressed urinary cotinine levels as ratio of cotinine to creatinine (nanograms per milligram).

Data analysis. Out of a total of 3,330 women eligible for the study, the two questionnaires were returned by 2,552 subjects (76.7%). The response rate varied slightly according to study center (highest in the Po River Delta, 84%; lowest in Viterbo, 73.4%). A comparison of the characteristics of participants versus nonparticipants revealed that participants were older, had a higher educational level, and were more likely to be employed than nonparticipants. A check of the smoking status of the participants revealed that 217 women were active smokers at the time of the study (most had started smoking in the period since the previous interview), and they were subsequently excluded from the analysis. Out of 2,335 confirmed never-smokers (negative answer to the question "have you ever smoked cigarettes?"), there were 2,072 in the 25–74 age range; among them, 1,633 (78.8%) participated in the medical examination and 1,617 (78%) gave blood to be tested. We finally excluded 112 women who had never been married and 22 women for whom smoking status of the husband was unknown. In total, we included in the present analysis 1,938 women, 25–74 years of age, ever married, and confirmed to have never been smokers.

Nonsmoking women ever exposed to their husbands' smoking were compared with the category of unexposed women for several factors: education, husband's education, household crowding, number of children, current or past occupation, exposure to toxic substances at work (dust, gas, fumes, and chemicals), parental diseases (asthma, chronic respiratory diseases, heart conditions, cancer), self-perceived health status, physician-diagnosed health conditions (hypertension, hypercholesterol, diabetes, osteoporosis, chronic respiratory diseases), blood pressure medications, lifestyle, and preventive behaviors (regular vigorous physical activity, supplemental minerals and vitamins, frequency of Pap test, mammography, and breast self-examination). We examined the following dietary groups: pasta and rice, meat, cooked vegetables, fresh vegetables, tomatoes, fruit, citrus fruit (oranges, tangerines, kiwi), fruit rich in β-carotene (apricots, peaches), olive oil for dressing, butter for cooking, and wine. The categorization for all the variables to be examined was decided *a priori* on the basis of the frequency distribution in the overall sample.

The data analysis of the categorical variables followed the approach used by Matanoski et al. (*9*). We analyzed the association between exposure to spousal smoking and women's characteristics using odds ratios (OR; and 95% confidence intervals, CI) calculated from logistic regression models. The odds ratios express the relative odds of the occurrence of the variable in women with spouses who smoked compared with that in women with spouses who did not smoke. It should be considered that the OR overestimates the prevalence rate ratio when the outcome under study is not rare (*24*). The ORs were always adjusted for the study area (center), age (five classes), and women's education (four classes) as a measure of

Table 2. Odds ratios for parental diseases and personal medical conditions of women unexposed and exposed to husbands' smoking, 1997–1998.

	Husbands' smoking				
	Unexposed (n = 741)	Exposed (n = 1,212)			
Variable	n	n	OR[a]	OR[b]	95% CI
Parental asthma					
No	615	996	1.00	1.00	—
Yes	111	216	1.12	1.08	(0.84–1.41)
Parental chronic respiratory disease					
No	573	944	1.00	1.00	—
Yes	153	268	1.02	1.03	(0.81–1.29)
Parental heart disease					
No	454	772	1.00	1.00	—
Yes	272	440	0.88	0.89	(0.73–1.08)
Parental history of cancer					
No	512	790	1.00	1.00	—
Yes	214	422	1.19	1.20	(0.98–1.47)
Self-perceived health status					
Very good	125	245	1.00	1.00	—
Good	467	748	0.97	0.98	(0.76–1.26)
Poor	127	202	1.04	1.09	(0.78–1.52)
Physician-diagnosed health conditions					
Hypertension					
No	620	1,003	1.00	1.00	—
Yes	106	209	0.99	0.97	(0.73–1.28)
Hypercholesterol					
No	614	1,032	1.00	1.00	—
Yes	112	180	0.76	0.75	(0.57–0.97)
Diabetes					
No	700	1,172	1.00	1.00	—
Yes	26	40	0.75	0.72	(0.43–1.22)
Osteoporosis					
No	671	1,091	1.00	1.00	—
Yes	55	121	0.98	0.95	(0.66–1.37)
Chronic obstructive pulmonary disease					
No	715	1,173	1.00	1.00	—
Yes	11	39	1.78	1.75	(0.88–3.47)
Women taking blood pressure medications					
No	654	1,056	1.00	1.00	—
Yes	72	156	1.09	1.12	(0.80–1.56)

Totals may vary because of missing values.
[a]Odds ratio adjusted for center, age, and center × age. [b]Odds ratios adjusted for center, age, center × age, and woman's education.

socioeconomic status. Because the age distributions differed among centers, we also had a center-by-age interaction term in the model.

The following continuous variables were considered for the women who attended the medical examination and had a blood test: urinary cotinine/creatinine, systolic and diastolic blood pressure, body mass index (BMI; weight/height^2), waist–hip ratio, triceps skin fold, α- and β-carotene, retinol, L-ascorbic acid, α-tocopherol, lycopene, serum total and HDL cholesterol, and triglycerides. We used linear multiple regression to evaluate differences between those exposed and unexposed to smoking husbands after adjustment for study area (center), age, and women's education.

Results

Among the 1,938 women never-smokers under study, 62.5% (1,212) had ever been married to a cigarette smoker, and 25.8% (711) were still living with a husband who currently smoked. Smoking cessation of the husband was the cause of the difference for 561 women, while 150 subjects were no longer exposed because of death of the husband or divorce. The demographic characteristics of the nonsmoking women with respect to the husband's smoking history are reported in Table 1, which reports the number of unexposed and exposed cases; ORs adjusted for center, age, and center × age; and ORs (with 95% CI) after further adjustment for women's education. After adjustment for age and women's education, the likelihood of exposure was higher for those living in Pisa, Rome, and Viterbo compared to women living in the Po Delta. After adjustment for study center, older women and those with a lower educational level (contrasting < 6 years vs. > 13 years of education: OR, 1.54; CI, 1.04–2.28) were more likely to have a husband who smoked than younger and more educated subjects. There was an increased odds of exposure for those having a husband of a lower educational level (6–8 years versus > 13 years of education: OR = 1.50; CI, 1.01–2.22) and for those living in more crowded dwellings (≥ 1 person/room vs. < 0.8 person/room: OR = 1.45; CI, 1.11–1.89). No associations were found for number of children, women's occupation, and exposure to toxic substances at work. However, homemakers and never-employed women had a lower likelihood of exposure than those employed in nonmanual jobs (OR = 0.72; CI, 0.53–0.99).

Exposure to spousal smoking was not associated with the women's reports of parental diseases or medical conditions (Table 2), with the sole exception of women with reported hypercholesterolemia who had a lower likelihood of exposure than women not reporting physician-diagnosed hypercholesterolemia. Women with a parental history of cancer tended to have a higher likelihood of exposure than those without parental history (OR = 1.20; CI, 0.98–1.47).

When considering lifestyle and preventive behaviors (Table 3), women taking vitamin supplements were more likely to be married to a smoker (OR = 1.45; CI, 1.05–2.01). No associations were found for vigorous physical activity, or for the frequency of Pap test, mammography, or breast self-examination.

Table 4 presents the association between dietary variables and smoking habits of the husband. Women married to a smoker were significantly less likely to eat cooked vegetables (OR = 0.72; CI, 0.55–0.93) or fresh vegetables (including salads; OR = 0.63; CI, 0.49–0.82) more than once a day. No other statistically significant associations were found.

A total of 1,249 measurements of urinary cotinine were available, 462 among unexposed and 787 among exposed women. Only 8 subjects (0.6%) had a value > 100 ng/mg creatinine (all were < 300 ng/mg), 0.8% and 0.4% among exposed and unexposed subjects, respectively. Different cutoff points of urinary cotinine have been suggested to separate nonsmokers from active smokers [from 50 to 150 ng/mg creatinine (*25*)], and a level > 100 ng/mg might suggest either an exceptionally high exposure to ETS or active smoking. After excluding subjects with a level > 100 ng/mg, the urinary cotinine/creatinine ratio was 6.46 ng/mg among nonexposed women, and it was significantly higher (2.94 ng/mg; $p < 0.001$) among exposed individuals (Table 5). No differences between women married to a smoker and those married to a nonsmoker were found for all the other variables collected during the physical examination or for the laboratory data (Table 5), although the serum concentration of L-ascorbic acid was marginally lower in the exposed than in the unexposed women ($p = 0.08$).

Although we were mainly interested in the differences between women ever exposed to a smoking husband and women never exposed, we reran all the analyses for the variables collected through the questionnaires considering women still living with a current smoker (501 subjects) in comparison with never exposed (741 subjects). All the results were similar to what had been found in the main analysis, and no additional differences were detected (data not shown). Women married to a current smoker were significantly less likely to eat cooked vegetables (OR = 0.64; CI, 0.46–0.89) or fresh vegetables (including salads; OR = 0.57; CI, 0.41–0.78) more than once a day.

Discussion

We found that women married to a smoker had higher levels of urinary cotinine and were more likely to be of lower socioeconomic sta-

Table 3. Odds ratios for lifestyle and preventive behaviors of women unexposed and exposed to husbands' smoking, 1997–1998.

	Husbands' smoking				
	Unexposed (n = 741)	Exposed (n = 1,212)			
Variable	n	n	OR[a]	OR[b]	95% CI
Regular vigorous physical activity					
No	556	977	1.00	1.00	—
Yes	165	228	0.88	0.88	(0.69–1.11)
Supplementation with					
Vitamins					
No	664	1,074	1.00	1.00	—
Yes	62	138	1.40	1.45	(1.05–2.01)
Minerals					
No	657	1,075	1.00	1.00	—
Yes	69	137	1.22	1.23	(0.90–1.68)
Pap test					
Never	92	141	1.00	1.00	—
Rarely	155	310	1.14	1.17	(0.82–1.65)
Every 2–3 years	175	261	0.96	0.99	(0.69–1.42)
Every year	276	463	1.12	1.16	(0.83–1.62)
Mammography					
Never	365	565	1.00	1.00	—
Rarely	141	253	1.04	1.04	(0.80–1.35)
Every 2–3 years	134	222	0.96	0.96	(0.73–1.25)
Every year	67	147	1.30	1.30	(0.93–1.82)
Breast self-examination					
Never	225	389	1.00	1.00	—
Rarely	239	412	1.04	1.07	(0.84–1.36)
Every 2–3 months	126	181	0.87	0.90	(0.67–1.21)
Every month	122	220	1.12	1.14	(0.86–1.52)

Totals may vary because of missing values.
[a]Odds ratio adjusted for center, age, and center × age. [b]Odds ratios adjusted for center, age, center × age, and woman's education.

tus, to be married to a less educated husband, and to live in more crowded dwellings than women married to a nonsmoker. After adjustment for women's educational level, exposed subjects were more likely to supplement their diets with minerals and were less likely to eat vegetables (cooked or fresh) than unexposed women. However, all the other variables we investigated, including other dietary variables, results of the medical examination, and laboratory data, did not significantly differ between exposed and unexposed subjects.

The results of the present study regarding the socioeconomic factors associated with exposure to a husband who smokes are not surprising given the socioeconomic differences in the distribution of smoking habits in the adult Italian population. Smoking is more frequent in men of lower socioeconomic status, whereas the proportion of smokers is higher among women of higher social class (*26*). The differences that we found with regard to various indicators of social class (woman's and husband's education, crowding), with those in the lowest socioeconomic level being more exposed, clearly reflect gender and social class differences of smoking in Italy. Similar findings have been reported in studies conducted in the United States (*7,9,10*) and in the United Kingdom (*27*). However, homemakers and unemployed women in our study were less likely to be exposed than ever-employed subjects, a finding that may be peculiar to the Italian situation. Our results suggest the importance of using more than one variable related to social class to control confounding in studies aimed at evaluating the health effects of ETS exposure. However, when we considered in the regression models husband's education in addition to the women's education, no substantial changes in the degree of association between exposure to ETS and several women's characteristics were found. In some instances, social class may be considered as an effect modifier because the harmful health effects of passive smoking are detected in families of lower socioeconomic status where the proportion of exposed people and the intensity of exposure to ETS is high (*28*).

Table 4. Odds ratios for consumption of some foods by women unexposed and exposed to husbands' smoking, 1987–1998.

Variable	Husbands' smoking: Unexposed *n*	Husbands' smoking: Exposed *n*	OR[a]	OR[b]	95% CI
Pasta and rice					
Never	19	26			
< 1/day	210	350	1.00	1.00	—
1/day	396	628	0.96	0.97	(0.76–1.20)
> 1/day	96	202	1.18	1.15	(0.84–1.57)
Meat in general					
Never	13	25			
< 1/day	387	668	1.00	1.00	—
1/day	263	406	0.89	0.87	(0.71–1.07)
> 1/day	58	81	0.85	0.80	(0.56–1.15)
Cooked vegetables					
< 1/day	311	557	1.00	1.00	—
1/day	248	450	1.01	1.03	(0.83–1.28)
> 1/day	163	194	0.72	0.72	(0.55–0.93)
Fresh vegetables					
< 1/day	163	346	1.00	1.00	—
1/day	306	543	0.86	0.86	(0.67–1.09)
> 1/day	256	319	0.64	0.63	(0.49–0.82)
Tomatoes					
< 1/day	89	196	1.00	1.00	—
1/day	509	786	0.68	0.68	(0.52–0.90)
> 1/day	127	228	0.74	0.76	(0.54–1.06)
Fruit in general					
< 1/day	122	174	1.00	1.00	—
1–2/day	330	545	1.11	1.12	(0.85–1.48)
>2/day	270	490	1.08	1.09	(0.82–1.45)
Citrus fruit (orange, tangerine, and kiwi)					
< 1/week	50	83	1.00	1.00	—
2–4/week	233	390	1.08	1.11	(0.74–1.66)
> 4/week	443	731	1.10	1.13	(0.76–1.66)
Fruit rich in β-carotene (apricots, prunes, peaches)					
< 1/week	235	379	1.00	1.00	—
2–4/week	162	298	1.10	1.12	(0.86–1.46)
> 4/week	327	532	0.96	0.99	(0.78–1.24)
Olive oil for dressing					
No	57	94	1.00	1.00	—
Yes	657	1,105	0.69	0.70	(0.47–1.02)
Butter for cooking					
No	680	1,139	1.00	1.00	—
Yes	43	62	1.04	1.06	(0.69–1.61)
Wine					
Never	257	427	1.00	1.00	—
< 1 Glass/week	149	286	1.19	1.20	(0.93–1.56)
1–2 Glasses/day	218	322	0.83	0.84	(0.66–1.07)
> 2 Glasses/day	97	170	0.98	0.97	(0.72–1.32)

Totals may vary because of missing values.
[a]Odds ratio adjusted for center, age, and center × age. [b]Odds ratios adjusted for center, age, center × age, and woman's education.

Our results do not support previous reports of more frequent risk factors for cardiovascular diseases among exposed subjects—namely, hypertension (*9*) and elevated

There are indications from the United States and from the United Kingdom that women whose spouses smoke have poorer diets than unexposed women. Sidney et al. (*29*) found that carotene intake was significantly lower in those exposed in comparison to unexposed subjects among nonsmokers studied in the Kaiser Permanente system in California. Thornton et al. (*27*), in a study of British adults, reported that never-smokers reporting ETS exposure at home were more likely to eat less fruit and more fried foods than unexposed subjects. Matanoski et al. (*9*) reported lower dietary intake of vitamins A and C among nonsmoking women married to a smoker compared to unexposed subjects in the NHANES I in the United States. Kawachi and Colditz (*7*) found that women in the Nurses' Health Study reporting ETS exposure at home were more likely to be in the highest quintile of saturated fat intake. Steenland et al. (*10*) observed that ETS-exposed subjects in the NHANES III in the United States had a lower dietary carotene intake than unexposed individuals. No association between ETS exposure at home and diet, however, was found in a recent study from Switzerland (*11*). We found a lower intake of vegetables among exposed women in our study, a result that is in keeping with the evidence reviewed above. However, as in the Swiss study (*11*), it seems that the dietary pattern in this Italian population does not differ to a large extent between exposed and unexposed women. No significant association has been found for most of the items in the food-frequency questionnaire, nor for serum levels of vitamins.

Table 5. Difference in the results of physical exams and laboratory data among women exposed to husbands' smoking compared with unexposed subjects, 1997–1998.

	Husbands' smoking						
	Unexposed			Exposed			
Variable	*n*	Median	Mean ± SD	*n*	Difference	SE	*p*-Value
Cotinine/creatinine ratio (ng/mg)	460	4.84	6.46 ± 6.90	781	2.94	0.55	< 0.001
Systolic blood pressure (mmHg)	504	122.50	126.90 ± 18.57	843	−1.18	0.90	0.19
Diastolic blood pressure (mmHg)	505	80.00	77.25 ± 10.34	843	−0.13	0.54	0.814
Body mass index (kg/m^2)	509	25.08	25.92 ± 4.27	854	0.22	0.24	0.348
Waist–hip ratio	505	0.78	0.86 ± 0.68	852	−0.02	0.04	0.584
Triceps skinfold (mm)	504	24.00	23.95 ± 7.57	848	0.46	0.42	0.28
α-Carotene (ng/mL)	434	36.00	56.96 ± 69.41	755	−1.24	4.34	0.776
β-Carotene (ng/mL)	445	255.50	346.94 ± 350.45	774	−21.94	19.14	0.252
Retinol (ng/mL)	442	501.00	520.46 ± 291.53	778	−10.58	16.98	0.533
L-Ascorbic acid (mg/dL)	417	0.93	0.94 ± 0.36	724	−0.04	0.02	0.078
α-Tocopherol (ng/mL)	445	10471.65	10934.24 ± 4902.84	778	−78.42	292.26	0.788
Lycopene (ng/mL)	404	305.70	358.86 ± 224.24	692	18.84	17.58	0.284
Serum total cholesterol (mg/dL)	455	224.00	227.25 ± 49.7	777	−1.34	2.86	0.638
Serum HDL cholesterol (mg/dL)	455	50.00	50.67 ± 13.47	777	−0.80	0.79	0.314
Serum triglycerides (mg/dL)	454	75.00	89.78 ± 52.75	776	−0.12	2.99	0.968

Mean difference in exposed versus unexposed from linear regression analysis adjusted for center, age, and women's education.

BMI (*10*). The profile of cardiovascular risk in our study was rather similar among women married to a smoker and those married to a nonsmoker. There were no differences when considering self-reports of physician-diagnosed diseases, familial history, medication for blood pressure, physical activity, nor the results of physical exams (blood pressure, BMI, triceps, waist–hip ratio), nor the laboratory data (total and HDL cholesterol, tryglycerides). Considering that most of the variables related to a preventive behavior were also similar between the two groups, it seems that in the Italian situation, after having considered age and social class differences, women married to a smoker do not differ to a great extent from women married to a nonsmoker. Paradoxically, exposed women were more likely to take vitamin supplements than unexposed ones, a result that is in contrast with the findings in NHANES I (*9*). Our results may simply reflect chance or may indicate that women married to a smoker follow the husband in taking vitamins and minerals under the false belief that this may prevent cancer occurrence (*30*).

Our study was initiated to elucidate the potential extent of confounding of the association between ETS exposure at home and several health effects among adult nonsmoking women. Like the current study, other work that examined the association between ETS exposure at home and risk of ischemic heart disease (*31*) and lung cancer (*3,32*) and which considered several confounders, including dietary patterns, has reported that confounding was minimal. For instance, Steenland et al. (*31*) showed that controlling for many cardiovascular risk factors in the follow-up of the American Cancer Society cohort had a small effect on the risk estimates of the association between ETS exposure and heart disease (from 1.31 to 1.19 for men and from 1.25 to 1.23 for women). In a recent report, Brennan et al. (*32*) found no confounding by dietary items in the association between ETS and lung cancer in the European case–control study. Our results also suggest that the extent of confounding from other factors, if any, is minimal.

In conclusion, we found few differences in socioeconomic and dietary characteristics among nonsmoking Italian women exposed and not exposed to spouses who smoke. Such differences would likely be controlled for when investigating health effects of passive smoking.

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